Improving Reading and Math Performance Using a Competency-Based Educational Model

A proposal for the State of Utah

submitted by

IndiVisual Learning, LLC

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IndiVisual
sound sight touch

Introduction

IndiVisual Learning, LLC is submitting this proposal pursuant to an RFP based on

SB 154 concerning the future of public education in the State of Utah. This proposal

describes the application of competency-based education principles using

instructional software, with specific regards to supplementary and remedial

instruction of math and reading. Additionally, it applies the principles of a learning

support system, including the gathering, interpretation, and dissemination of student

performance data.

A. Overview

What are the IndiVisual programs? What are their prime characteristics?

IndiVisual Learning's (IVL) instructional software are competency-based products. They are designed to supplement core instruction and dramatically lessen the costs of remediation. They are student centered and learning centered. They are self paced, highly interactive, and encourage positive social development around solid academic success. They target the prime age range for computer based instruction. IndiVisual instructional software keeps records that enable a teacher to evaluate program effectiveness on a daily basis.

IVL Reading is a program for 4th to 7th graders who are not fluent readers. It is a single technique in which word-for-word reading is replaced with reading in meaning units, increasing comprehension and vocabulary.

IVL Math Whole Numbers and *Rational Numbers* are the first two programs in a series designed to maximize core mathematical concept learning. They target 3rd to 8th grade students who have not mastered operations related to whole and rational numbers. They are instructional hybrids drawing on both traditional and integrated instructional methods inside a learning object architecture. They are unique applications of competence based learning in software.

Summary of how our program fits within the RFP objectives

Increase student performance

INDIVISUAL READING

Students using *IVL Reading* have demonstrated one to one-and-one-half year gains in reading following as few as 40 lessons. These results are consistent in all tested schools in Minnesota and Texas. ESL students in rural Minnesota have shown similar gains in English reading comprehension.

INDIVISUAL MATH

For *IVL Math,* preliminary results of beta tests in Minnesota using a modified Third International Math & Science Survey (TIMSS) test indicate gains of over a year for all students.

How IndiVisual programs are highly cost effective

IVL software is more effective per dollar spent than one-on-one tutoring. It uses existing technical infrastructure and can be used at home, in public libraries, church computer labs as well as school. Record keeping adds no additional costs. Teacher involvement centers on using IVL records as a lead-in to other language-based activities. The program tracks performance and generates report to support these activities. Minimal teacher training is needed. They are highly effective owing to bringing students and teachers into the design process early and listening to them as we designed the programs.

B. Impact on target populations

Impact on key populations – student groups

INDIVISUAL READING

Top quartile

This program is not recommended for advanced readers. It is not a product for gifted and talented use even in an acceleration program.

Bottom quartile

This is where the best effects are obtained. Where students are below grade level by 1-3 years they recover lost ground at a faster rate than with no intervention or from tutoring.

Middle 50%

Performance here is more variable due to many factors. On the low side, gains stay at around a year with as few as 40 lessons. For students at the upper end of the middle stanines, there is less of a gap to close and the results reflect that.

INDIVISUAL MATH

The full value of *IndiVisual Math* is being researched. Preliminary data from a study of middle school students in Coon Rapids, Minnesota indicates a gain of nearly a year in as few as seven lessons.

Other specific populations

Migrant Education and ESL students at about the 4th to 6th grade level benefit the most. To read about the gains made by these students, please review the Sleepy Eye, Minnesota study at: *http://www.indivisuallearning.com/site/reading/research/readResearch.html*

Impact on teachers

Teachers are enabled to work with many students simultaneously whose learning styles and unique learning problems are best handled face-to-face. Since teachers can track performance daily by student or class from their computer it frees them to differentiate instruction better meeting the needs of all the students. IVL software requires no lesson planning or curriculum modification. These programs are extensions of what teachers reflexively do with individual students. What teachers like is that our programs set mastery as the performance standard and adapt social forces to sustain engagement. *IVL Reading* allows teachers to set the stage for greater immersion in literacy culture.

Impact on and benefits to other stakeholders

Administrators

The key benefit is making teachers more productive by better using available resources and working with many students simultaneously. Record keeping is automatic thus decreasing overall administrative loading.

Parents

IVL software is available when and where the student needs it. They can work at home if they have an Internet connection. This means parents can see exactly what their child is doing.

School boards

IVL software answers the need for accountability without increasing personnel costs and by replacing wasted computer time with productive use of the infrastructure. They get academic gains, teacher productivity gains, and parent awareness, which adds up to accountability and enormous cost savings for remediation.

Public policy makers

The proposal offers an opportunity to enact meaningful legislation that will produce results.

Higher education

There is limited impact on secondary education as these products are principally designed for elementary/middle school use and use with high school students based on reading proficiency. Higher education may wish to study the programs for their technical innovations and instructional methods and outcomes. As our programs target upper elementary and limited secondary use, they will have positive effects before a student enters college.

Employers

There is no direct impact as the targeted audience is too young for the workforce. However, employers increasingly complain they can't find entry-level workers who have adequate math and reading skills. These materials prevent and eliminate that problem years before these students are ready for the workforce.

Rationale for the program

Utah is like most states in that the need cuts across all districts, populations and circumstances. The big idea is to prevent failure early and avoid costs of remediation. It reduces need for expensive and invasive pullout programs, builds social bonds that increase desire to go to school and reinforces actual content mastery. These conditions are universal and no matter what state or district you are in, students at and just below the middle can automatically benefit without further assessment or additional governmental programs.

C. Why IndiVisual?

Why select IndiVisual over other programs?

- **Cost savings** over outside tutors and licensed in-school tutors range from 16 to 45 times *less* than the cost of these services (see p.16 for full cost/performance discussion).

- **Availability.** IVL software is ready *now*. We can ship and install today. For nominal development costs we can expand key elements in our products to address specific needs of statewide recordkeeping and creating, assigning and tracking worksheet performance.

- **Ease** of getting teachers and students up to speed. It takes a couple of hours to train teachers and IT staff in setting up class lists and getting students into the first lesson. No lengthy in-service, and fast, effective technical support. This comes at no additional charge with your instructional software.

- **Rigorous pedagogy.** *IVL Math* does not offer instruction on all possible topics. It goes straight to the heart of the concepts that a student must learn in order to progress.

- IVL programs are **competency-based**. They reflect the key elements of this paradigm.

- **Uses existing** computer/network infrastructure to better advantage.

- **Student acceptance.** If they play it once, they are hard to unplug. A strong socially reinforcing context quickly emerges, offering powerful social reinforcement to playing the programs.

- **Student satisfaction** with play action, control, order, and reinforcement.

- **Ability to modify content** quickly and test ideas quickly due to development methodology.

- Uses existing infrastructure and requires **no additional hardware purchases.**

"We're not seeing growth in incremental kinds of gains, we're seeing them in terms of leaps in gains."

John Manning, Ph.D. - Sr. Professor of Reading, College of Education, University of Minnesota, and designer of the IndiVisual Reading instruction, Minneapolis, Minnesota

D. Research to demonstrate workability of program

IVL has tested the effectiveness of our programs from the outset. We use pre- and post-measures and controlled experiments where possible. We also use N = 1 strategies (a strategy where a research subject serves as their own control) because classic experimental techniques are very difficult to use in school settings. We do a great deal of direct observation and student interviews and administer Learning Style inventories to better understand the relationships among student preferences and performance with computer based instruction.

IndiVisual research and results

INDIVISUAL READING

Our first study of the *IVL Reading* program was undertaken at Richard Green School in Minneapolis. This is a hardcore inner city school. *IVL Reading* was tested and found to produce a 1.2 year gain in as few as 20 lessons. This groundbreaking study revealed the issues found in any controlled research in a school. The entire study is available as a PDF file found at: *http://www.indivisuallearning.com/site/reading/research/readResearch.html*

There are two other studies done in South Saint Paul and in Houston that show program effectiveness as a function of the number of lessons completed. A trend was detected, but further research to establish its strength needs to be undertaken. Please read the entire report at: *http://www.indivisuallearning.com/site/reading/research/readResearch.html*

INDIVISUAL MATH

We have preliminary results for the *Rational Numbers* program from a study done at Northdale Junior High in Coon Rapids, Minnesota. Thirty students participated. They were assessed using a TIMSS-based test that we devised. Results will start to come in this December.

> **"With IndiVisual Learning, we're going about improving test scores the right way."**

Tom Wicks, Ph.D. - Curriculum Consultant, South St. Paul Public Schools, South St. Paul, Minnesota

How our program fits within broader research

Our programs highlight the need for a new and innovative set of tactics and strategies for testing instructional effectiveness. As the National Research Council points out, doing experimental research in schools is nearly impossible. Mastery-based programs that collect data can be mined for trends that will eventually yield predictive models. That will require large scale adoption and several years of use to establish reliable and valid data.

Summary of results promised from program

Using *IVL Reading,* students in 4th to 7th grade whose initial grade reading levels are from 6 months behind (at the fourth grade level) to three years behind (6th and 7th graders) will gain at least a year in reading level using the program about 40 hours.

For those using *IVL Math*, preliminary results indicate two year gains are expected. It takes approximately 20 hours to complete the *Whole Numbers* program and we are estimating about the same time for completion of the *Rational Numbers* program, provided the students have taken the *Whole Numbers* program first.

Methods to measure and evaluate the initial and ongoing program results

Measurements

We use before and after testing with national or internationally normed tests. For reading we use the Gates-MacGinnity test, and for math we use a modified TIMSS assessment. Teachers track daily performance. Error detection and feedback in the math programs offer a measure of continuous assessment to keep the students and teachers apprised of daily performance.

Reports

Student performance is collected and presented in several formats, permitting examination of individual or class performance. This database, over time, will become a very useful asset for building a predictive model.

Evaluations and assessments

Within each program are a variety of measures to document performance. We track many elements and all student input. At all points in the programs useful feedback is presented in a context-sensitive manner. Preliminary assessment and mid-stream assessment are conducted along with an end-of-lesson assessment to determine whether the student has achieved mastery.

E. Pilot program

Implementation of program

Minimum scale

A useful pilot will involve at least four elementary schools that can yield 100 test condition students and matched controls. They would be matched along as many social and economic variables as possible. One set of two would receive the programs while the matched controls would not. Performance on pre- and post-measures would be compared along with standardized test scores from the year previous to the introduction of the programs and track the students through the years using the programs and for a year after to establish duration and long term strength of the effects.

Recommended scale and ramp up

Following each semester we would double the number of schools involved. At semester three, all the control schools would be moved to the program. The technical difficulty to do this is negligible.

Timeline for rollout to state

• Year 1, first semester, controlled test. Second semester expansion that doubles pilot;

• Year 2, full state rollout. Full statewide rollout can occur at any time there is sufficient confidence the program is beneficial. As field data support increased scale we are ready to meet the demand regardless of scale.

Initial Utah school districts already expressing interest
- Utah's Electronic High School
- Weber County School District
- Ogden City School District

Budget of time and money

Cost to develop

The programs described here can be used in their current forms. However, as was indicated in the 1st round RFP, we can further develop capabilities for lateral use to expand overall exposure in a school.

For example, while our reporting works well for teachers, it will take additional time and money to enable all the data about performance to be captured to a district or state level database. We can quickly establish a connection to Blackboard.com for uniform statewide reporting. Students using IVL software via the electronic high school may use some other student tracking system such as *WEB CT, Docent* or that used by the learning support system used by the pilot project in support of competency-based education.

The cost for developing linking capability to Blackboard is estimated at $3,000.

Another area to see further development is is expanding the *MathToolKit* to a distinct product that creates worksheets and permits the student and teacher to directly communicate. This capability is not needed for immediate deployment.

The cost is $11,000.

Cost to implement minimum-scale pilot

Rates are $30 per student for the *Math* programs and $100 for *Reading*. If we have 100 students in the program, the cost is $3,000 for *Math* and $10,000 for *Reading*.

Cost to maintain once implemented

Maintenance costs are factored into the price. The cost of research over the life of the pilot study is estimated at: $3,700.

Cost to roll out

As the programs can be played from school servers, it is the time for school IT to install and test (two days per school) and the cost per student for the program software. These costs are rolled up into the selling (licensing or user fee) price.

Technology and other Intellectual Property

Requirements

Technical specifications for LAN set up and client requirements are:

Windows: 266 mHz processor, Win95 or higher, 128 MB RAM, Quicktime 5, Internet Access.

Macintosh: 333 mHz processor, OS9, 128 MB RAM, Quicktime 5, Internet access

Stage of development

As indicated, our products are ready now. In terms of product development, changes to our database to enable migration to a larger repository requires identification of those data structures to which the data would migrate and estimates of programming a communications link made at that point. At present the Utah Electronic High School uses Blackboard.com for recordkeeping. There will be a cost associated with linking to any yet unspecified data collection system.

Ownership/licensing

Training required to implement

Teachers

Training is minimal and serves mainly to introduce recordkeeping and student assignment. There is a small amount of pedagogical orientation. Training will last no more than 2 hours.

Others

IT staff will be briefed on installation procedures for LAN deployment and for client operation. Depending upon the size of the installation and particular needs in a school, installation can take between two hours and two days.
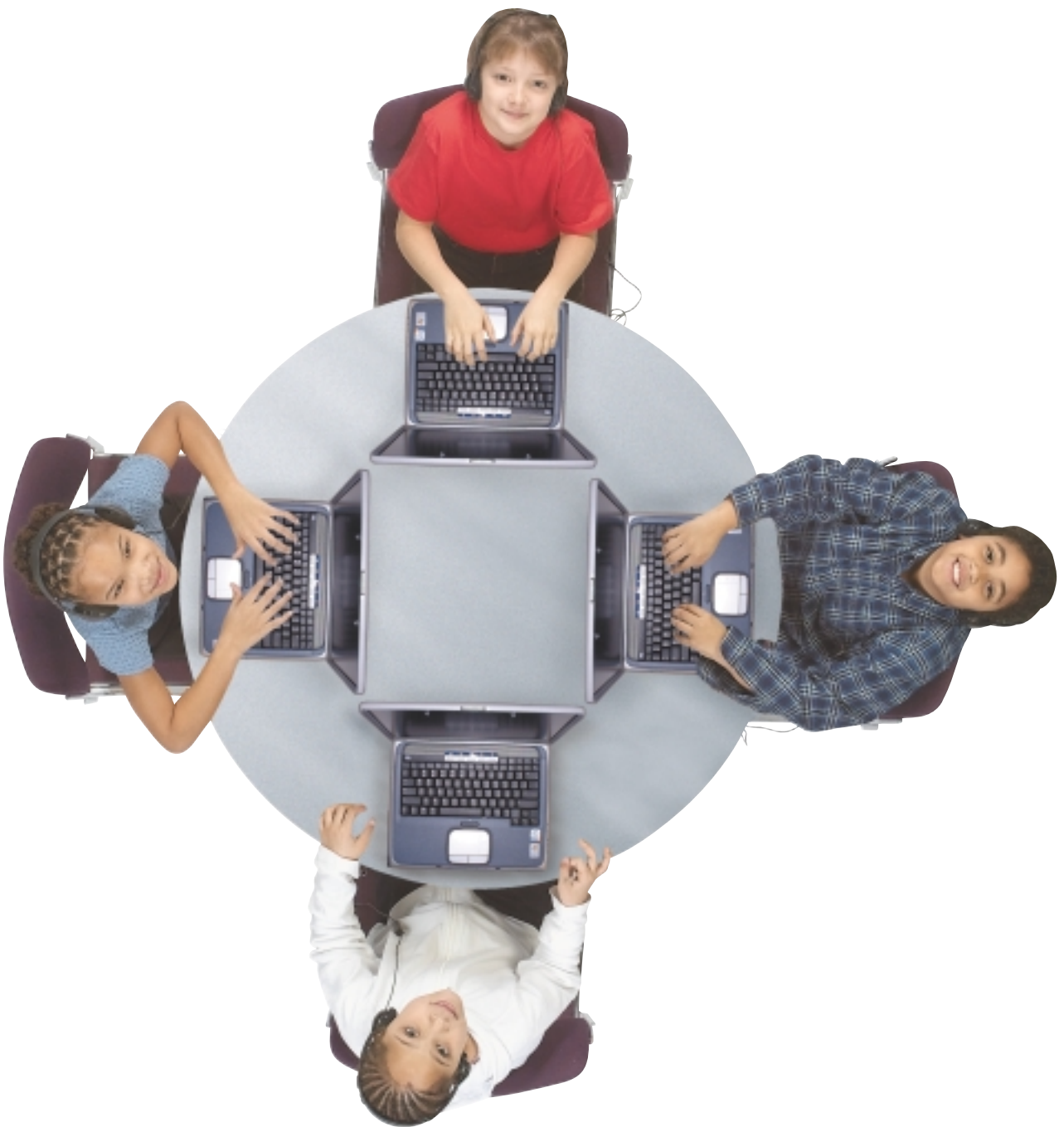
F. Economic model

Cost savings

The cost factor differences between *IVL Math*, for one example, and serving the same number of students with a private tutor or an in-school tutor can range from 15 to 50 **times** the cost.

Pilot includes 100 students in the experimental condition. They are 5th, 6th, and 7th grade students. It takes approximately 18 hours to complete *Whole Numbers*. Preliminary data suggests a two grade bump in achievement as measured by the TIMSS test constructed to match our concepts taught. Therefore, 18 hours will be used as a benchmark.

The big question to which everyone wants an answer

What is the cost of remediating a student to achieve a full year gain in math or reading? One answer is $30 per student using *IVL Math* and $100 per student using *IVL Reading*. The other answer is: What does it cost a school in Utah to achieve the same outcome?

Provider	Subject	Time	Cost	$ per student	Total Cost (pilot)
IVL	Reading	40 hrs	$100	$100	$10,000
IVL	WN Math	18 hrs	$30	$30	$3,000
IVL	RN Math	18 hrs	$30	$30	$3,000
Private tutor	any	36 hrs	$37-41/hr	$1,332–1,476	$133,200–147,600
School tutor	M or R	40 hrs	$12-30 hr	$480–1,200	$48,000–120,000

"Teachers are able to monitor the students' progress… and get immediate feedback."

Pamela Johnson - Title I Coordinator, New Dowling Middle School, Houston, Texas

G. Team

The IndiVisual Learning team has earned its credibility by actually designing and building instructional software that works. We adapt to a computer environment immersive multimedia that at a minimum is better than a book and in many ways is also superior to human tutoring. We are not developing core or basal materials and therefore support and reinforce the primary role of the teacher.

Credentials

John Manning, Sr. Professor of Reading, University of Minnesota

Dr. Manning is the author of the Dick, Jane and Sally reading series and many other major series. He is a world renowned authority on teaching reading. He is past president of the International Reading Association.

Jeff Koon, PhD, Lead researcher

Dr. Koon earned his doctorate at University of California, Berkeley. He also performs extensive research for the Saint Paul Public Schools.

Mike Reiners, licensed elementary and secondary math teacher

Mr. Reiners has nearly 10 years experience in teaching elementary and secondary math.

Tom Shaff, IVL Creative Director

Mr. Shaff's first computer-based instructional program shipped in 1981. His background is learning theory and is currently a graduate student in Gifted Education at the University of St. Thomas in Saint Paul.

Experience

We are veterans of building what teachers want and what students like. We have among us, nearly 50 years of design, programming, and project experience.

Why/how able to deliver

Delivery of shrinkwrapped products is available immediately.

Appendix

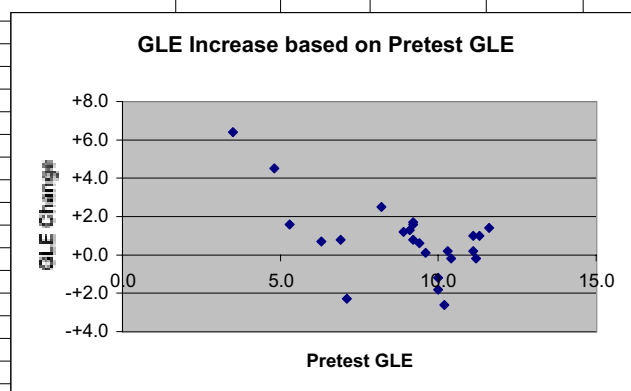**Summary of IndiVisual Reading program research**

School year 2002-2003

| School	Sample Characteristics	Pre post scores	Notes
Public small town	A. Experimental 23 5th graders B. Control 29 5th graders	45.2-52.0 NCE 51.8-51.1 NCE	IVL's best exp/control study Supplemental use Some boostings to Levels 2,3; many Ss completed 80+ lessons
Private small town	C. Experimental 44 4th-6th graders C. Control 40 4th-6th graders	56.3-62.4 NCE 54.7-58.6 NCE	IVL's best same-school exp/control study. IVL supplemental, Most boostedto level 3 Mean # of lessons completed = 54 One very strong teacher on control side?
Private City	D. Experimental 48 5th-6th graders E. Control 18 5th-6th graders	50.4-55.2 NCE 56.1-55.7 NCE	Weak exp/control pair, omits many readers above 8.0. IVL subst for silent reading. Most boosted to Level 3 Mean # of lessons =25 Lowest tiers of readers showed more progress. Very high percentage of readers above 8.0 to start.
Public Suburb	F. Special exp 32 2nd & 3rd graders F. Exp 59 3rd-5th graders F. control 54 3rd-5th graders	78.8-76.8 NCE 54.7-57.5 NCE 65.9-68.4 NCE	Grade level groupings by skill levels, difficult matchingIVL substituted varies by teacher. Most boosted to levels 2-4, using prev Spring test Mean # of lessons 30.9(Spec) and 35.2 (E, biggests and smallest NCE gains both in E group
Public small town	G. Experimental 52 4th graders G. control 51 5th graders	51.8-50.5 NCE 44.0-41.6 NCE	E/C divided by grade level-not ideal. IVL subst for silent reading. Difficult year for whole school? Much variation by teacher in IVL use (42.3 to 77.1). Biggest NCE gains and losses were in E group (highest use yielded best gains) Nature of T integration of IVL likely affected
2001-2003			
Big city public	H. Entire group 57 4th-5th graders	28.9-40.7 NCE	Supplemental to SFA programming Mean # of lesson completed was 62.9
Inner ring suburb Public	I. TAAS TLI below 70 6th-7th graders	20.9-23.1 NCE	Supplemental NCE based on TAAS, with higher norms at posttest. Equiv gain in TLI pts was 8 (68.3lessons). Slosson Oral Reading went from GE 5.1to 6.6 from May to May (86.7 lessons).
Big city public	J. Reading level 4.0-4.9 7th graders K. TAAS TLI below 70 6th-8th graders	23.4-29.3 NCE 17.5-22.7 NCE	Supplemental NCE based on TAAS with higher norms at Postest. Equiv gain in TLI pts was 10 (37.6lessons). NCE based on TAAS with higher norms at posttest. Equiv gain in TLI pts was 10.4 (30.3 lessons).
Small town public	L. init reading varies 7thgraders	48.6-57.5 NCE	Supplemental NCE based on TAAS, with higher norms at posttest. Equivalent gain in TLI pts was 5.4 (76.7 lessons)

Appendix

Summary of IndiVisual Rational Numbers Math program research

Student	PreScore	PreGLE	PostScore	PostGLE	Change	Lessons	L/G Index	
S1	33.30	3.5	62.95	9.9	**6.4**	7	1	
S2	39.18	4.8	57.90	9.3	**4.5**	8	2	
S3	50.75	8.2	70.47	10.7	**2.5**	3	1	
S4	57.06	9.2	72.54	10.9	**1.7**	9	5	
S5	57.59	9.2	71.73	10.8	**1.6**	5	3	
S6	40.70	5.3	45.82	6.9	**1.6**	8	5	
S7	81.38	11.6	**100.00**	13.0	**1.4**	11	8	
S8	56.48	9.1	67.51	10.4	**1.3**	4	3	
S9	55.16	8.9	64.32	10.1	**1.2**	12	10	
S10	77.07	11.3	90.88	12.3	**1.0**	8	8	
S11	75.09	11.1	87.83	12.1	**1.0**	8	8	
S12	57.69	9.2	63.53	10.0	**0.8**	4	5	
S13	45.78	6.9	48.65	7.7	**0.8**	7	9	
S14	43.79	6.3	45.96	7.0	**0.7**	4	6	
S15	58.94	9.4	63.80	10.0	**0.6**	4	7	
S16	74.97	11.1	78.11	11.3	**0.2**	12	60	
S17	66.41	10.3	68.70	10.5	**0.2**	9	45	
S18	60.56	9.6	61.06	9.7	**0.1**	11	110	
S19	76.74	11.2	73.46	11.0	**-0.2**	10		
S20	67.44	10.4	66.00	10.2	**-0.2**	7		
S21	64.17	10.0	54.46	8.8	**-1.2**	8		
S22	63.82	10.0	50.75	8.2	**-1.8**	3		
S23	46.56	7.1	39.27	4.8	**-2.3**	0		
S24	65.47	10.2	48.26	7.6	**-2.6**	7		
Averages:	59.00	8.9	64.75	9.7	**0.8**	7.0	9	
			Mild outliers are outside		**+ or - 2.1**	from the mean		
Omitting outliers:	61.46	9.4	68.15	10.2	**0.8**	7.6	10	

GLE Increase based on Pretest GLE

	r=	Line of Best Fit:
		y = -0.51x + 5.34

-0.57876836

	Full	Skimmed
L whisker	0.02	0.20
L box	0.78	0.60
R box	0.65	0.55
min	2.6	1.4
max	5.0	1.2
offset	0.3333	0.6667
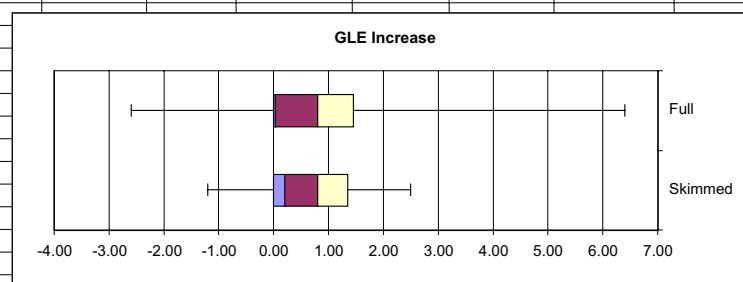
GLE Increase

Appendix

Summary of IndiVisual Rational Numbers Math program research

Student	PreScore	PreGLE	PostScore	PostGLE	Change	Lessons	L/G Index	
S1	39.90	5.2	75.85	11.2	**6.0**	4	1	
S2	32.84	3.5	51.24	8.2	**4.7**	8	2	
S3	45.16	6.7	64.67	10.1	**3.4**	11	3	
S4	44.94	6.7	57.23	9.2	**2.5**	9	4	
S5	32.20	3.4	42.04	5.8	**2.4**	12	5	
S6	64.25	10.0	91.06	12.3	**2.3**	9	4	
S7	67.75	10.4	93.06	12.5	**2.1**	14	7	
S8	56.48	9.1	67.51	10.4	**1.3**	4	3	
S9	62.56	9.9	76.22	11.2	**1.3**	10	8	
S10	62.94	9.9	76.15	11.2	**1.3**	11	8	
S11	57.97	9.3	66.89	10.3	**1.0**	8	8	
S12	75.40	11.1	88.41	12.1	**1.0**	12	12	
S13	71.16	10.7	80.96	11.6	**0.9**	10	11	
S14	56.36	9.1	62.74	9.9	**0.8**	12	15	
S15	63.27	9.9	68.61	10.5	**0.6**	11	18	
S16	78.51	11.4	85.30	11.9	**0.5**	8	16	
S17	75.33	11.1	81.20	11.6	**0.5**	12	24	
S18	64.29	10.1	68.41	10.5	**0.4**	12	30	
S19	78.16	11.3	81.87	11.6	**0.3**	16	53	
S20	46.51	7.2	44.32	6.5	**-0.7**	0		
S21	58.69	9.4	52.98	8.5	**-0.9**	10		
S22	50.39	8.3	40.06	5.1	**-3.2**	8		
Averages:	58.41	8.8	68.94	10.4	**1.6**	9.6	6	
			Mild outliers are outside		**+ or - 2.6**	from the mean		
Omitting outliers:	61.15	9.3	71.03	10.4	**1.1**	10.1	9	

GLE Increase based on Pretest GLE

GLE Increase

Line of Best Fit:
$y = -0.43x + 5.38$

r= -0.5405846

	Full	Skimmed
L whisker	0.50	0.50
L box	0.50	0.50
R box	1.25	0.70
min	3.7	1.4
max	3.8	1.7
offset	0.3333	0.6667

IndiVisual Learning, LLC

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